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10/582,929	04/12/2007	Stephen Wayne Beadle	2003 B136/2	6582
23455 7590 06/07/2011 EXXONMOBIL CHEMICAL COMPANY 5200 BAYWAY DRIVE P.O. BOX 2149 BAYTOWN, TX 77522-2149				
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ETHERTON, BRADLEY				
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

# Office Action Summary

**Application No.**

10/582,929

**Applicant(s)**

BEADLE ET AL.

**Examiner**

Bradley Etherton

**Art Unit**

1772

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 15 October 2010.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-11, 13, 16, 18-20 and 22 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-11, 13, 16, 18-20 and 22 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-840)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB-08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 15, 2010 has been entered.

Claims 1-11, 13, 16, 18-20, and 22 are pending. Claims 12, 14-15, 17, and 21 have been canceled. New claim 22 is acknowledged.

### ***Response to Arguments***

Applicants argue that **Cavani**, et al. ("Effect of Water in the Performance of the 'Solid Phosphoric Acid' Catalyst for Alkylation of Benzene to Cumene and for Oligomerization of Propene", Appl. Catal. A, 97 (1993) 177-196) is directed to a solid phosphoric acid while the claims are limited to zeolite catalysts. Applicants further argue that there is no reasonable expectation of success that a zeolite catalyst could be substituted for a solid phosphoric acid catalyst in a olefin oligomerization process. This argument is not considered persuasive because **Cavani** discloses that direct substitution of a zeolite catalyst for a solid phosphoric acid catalyst is known (p. 178, 1<sup>st</sup> paragraph).

Applicants argue that water's role and function in oligomerization processes relating to solid phosphoric acid catalysts and zeolite oligomerization catalysts is completely different. Applicants argue that one of ordinary skill in the art would not expect the water used in **Cavani** to be used successfully or even usefully in the claimed process. The Examiner agrees with Applicants that water serves a different function in the two acid catalysts. However, both the **Cavani** and the Mathys, et al. (**WO 93/16020**) references cited in the previous Office Action explicitly teach that water is useful and may function to increase the activities and useful lives of solid phosphoric acid oligomerization catalysts and zeolite oligomerization catalysts. Thus, one of ordinary skill in the art would understand the benefits of water addition and be led to add water, even though water functions differently from how the user may believe. Therefore, this argument is not considered persuasive.

Applicants argue that **WO 93/16020** exemplifies and suggests feeding water into the oligomerization process at or close to fixed rates within specific ranges through-out a reactor run. Thus, neither **Cavani** nor **WO 93/16020** disclose or suggest the combination of specific ranges for the water content in the initial phase and latter phases of the process. This argument is considered persuasive, therefore, the previous rejections of claims 1-11, 13, 16, and 18-20 under 35 USC 103(a) are withdrawn.

However, on reconsideration, new grounds of rejection are presented.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 5, 8-9, 13, 18, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mathys**, et al. (U.S. 5,672,800), in view of **Garwood**, et al. (U.S. 4,150,062).

In regard to claim 1, **Mathys** discloses a process for olefin oligomerization (Abstract). The process involves the following:

(a) A feed comprised of at least C<sub>2</sub> to C<sub>12</sub> olefins, preferably propylene or butene (col. 2, lines 7-18).

(b) The process produces C<sub>5</sub> to C<sub>20</sub> olefins (col. 2, lines 14-15. Since an olefin carbon number range of 5 to 20 overlaps the carbon number range of 6 to 15, the range recited in claim 1 is considered *prima facie* obvious.

(c) The olefin feed is continuously passed through a water saturator in order to introduce water into the reactor feed (col. 8, lines 1-10). **Mathys** provides an example in which propylene is the feed to the oligomerization process (Example 1).

(d) The water-containing feed is contacted with a bed of ZSM-5 zeolite catalyst in the reactor at the oligomerization conditions shown, for example, in Table 1A.

(e) Olefinic oligomers, i.e., olefin conversion products, are produced in the process (col. 1, lines 3-5).

**Mathys** discloses that the water content of the feed may range from 0.05 to 0.5 mole% (col. 6, lines 42-43). Therefore, the water content of the olefin feed can be estimated to range from about 210 wt ppm to about 1070 wt ppm. Since a water content range of about 210 wt ppm to about 1070 wt ppm overlaps the ranges of 450 to 800 wt ppm and 250 wt ppm to 400 wt ppm, the ranges recited in claim 1 are considered *prima facie* obvious.

**Mathys** does not appear to explicitly disclose that the water content of the feed is from 450 to 800 wt ppm during the initial phase of the process and decreases to 250 to 400 wt ppm during the latter phase of the process.

However, **Garwood** discloses a process for converting light olefins, i.e., C<sub>2</sub> to C<sub>4</sub> olefins, to high octane olefinic gasoline components (Abstract). Therefore, the process is considered to be an olefin oligomerization process. The process involves the following:

(a) The feed to the process is a mixture of olefins and water (col. 1, lines 57-62). Propylene, butene, and their mixtures are preferred (col. 9, lines 58-61).

(b) The feed is contacted with a zeolite catalyst. Suitable zeolites include ZSM-5 (col. 2, lines 12-17).

**Garwood** discloses that the activity of the zeolite oligomerization catalyst changes as a function of time (col. 16, lines 34-50 and Table 7). **Garwood** teaches that the process may be operated as follows:

(a) A high level of water, i.e., a high water/olefin mole ratio, is fed along with the olefin during the initial stages of the process, i.e., during start-up. At the outset (0.7 days on stream, Table 7) the zeolite catalyst has particularly high activity and the conversion is high (90%).

(b) Lower levels of water, i.e., a lower water/olefin mole ratios, are fed at later stages of the process. **Garwood** teaches that the conversion stabilizes, i.e., reaches steady state, at the lower water concentrations (col. 16, lines 42-46).

Therefore, **Garwood** teaches that the introduction of high levels of water to the process as the catalyst starts up, i.e., in the initial phase, and then lower levels of water as the catalyst stabilizes, i.e., at the latter phase, are result effective variables for attaining stable operation of an oligomerization process which utilizes a ZSM-5 catalyst. Choosing to introduce water such that the water content of the feed is 450 to 800 wt ppm during the initial phase, i.e., start-up, and reduce the water content of the feed to 250 to 400 wt ppm during the latter phase, i.e., steady-state operation, is considered process optimization. It is well settled that determination of optimum values of cause effective variables such as these process parameters is within the skill of one practicing in the art. See MPEP 2144.05(II).

Therefore, at the time of the invention, it would have been *prima facie* obvious to one of ordinary skill in the art to modify the process of **Mathys** and control the relative amount of water as taught by **Garwood** because (1) this involves application of a known start-up technique to improve a known zeolite oligomerization process to yield predictable results and also because (2) the increased levels of water at start-up result in high conversions which would otherwise require long times to attain.

In regard to claim 5, **Mathys** discloses that the water content of the feed is controlled with a thermostatted water saturator, i.e., a water wash (col. 2, lines 44-53). The amount of water is controlled by controlling the temperature of the saturator.

In regard to claim 8, **Garwood** discloses that the boiling point and octane number of the products are measured (Table 7). Since boiling points and octane number are measured, the products must have been separated from unreacted olefinic feed.



In regard to claim 9, **Mathys** discloses that an objective of the process is to increase the yield of the oligomers (col. 2, lines 1-7). Therefore, it is considered *prima facie* obvious to recycle unreacted olefins because recycling will increase the yield of oligomer produced by the process.

In regard to claim 13, **Mathys** discloses that the olefinic feed may be a propylene and/or butene feedstock (col. 2, lines 17-18). This is considered to include propylene, butene, and mixtures of propylene and butene.

In regard to claim 18, **Mathys** discloses oligomerization temperatures ranging from 180°C to 255°C. Since a temperature range of 180°C to 255°C overlaps the temperature range of 110°C to 310°C, the range recited in claim 18 is considered *prima facie* obvious.

In regard to claim 22, **Mathys** discloses an example of a feed comprised of about 49 wt% propylene, 48 wt% propane, and a balance comprised of ethane and butane (Example 1). This is calculated to be about 50 vol% propylene. Since an example of 50 vol% olefin falls in the range of about 35 vol% to 60 vol% olefin, the range recited in claim 22 is considered *prima facie* obvious.

Claims 2-3 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mathys**, in view of **Garwood**, as applied to claim 1 above, and further in view of **Edgar**, et al. ("Process Control" in Perry's Chemical Engineer's Handbook, J. Wiley & Sons, D. W. Perry and R. H. Green, eds., 7<sup>th</sup> ed., 1997, available on-line at [www.knovel.com](http://www.knovel.com)).

In regard to claim 2, **Mathys**, in view of **Garwood**, discloses the process of claim 1, as discussed above. **Mathys** further discloses that the water content of the feed is controlled with a thermostatted water saturator, i.e., a water wash, by controlling the temperature of the saturator, as discussed above. **Mathys**, in view of **Garwood**, does not appear to explicitly disclose that the water content of the feed is automatically controlled according to an analysis of the composition of the reaction feed.

However, **Edgar** discloses that adequate control of chemical reactions requires control of stoichiometry and feed rates of the different components (p. 8-33 and 8-35, Composition Control). Several types of analyzers are useful for measuring the composition of process feeds in order to facilitate control of stoichiometry and feed rates of the different components (p. 8-50, Chemical Composition Analyzers). **Edgar** discloses that such control is typically done automatically by a distributed control system (p. 8-4).

Therefore, at the time of the invention, it would have been *prima facie* obvious to one of ordinary skill in the art to modify the process of **Mathys**, in view of **Garwood**, and include automatic control of the water and feed composition as taught by **Edgar** because (1) this involves application of a known process control method to improve a known process to yield predictable results and also because (2) composition control is the first requirement for successful control of a chemical reactor (**Edgar**, p. 8-33, Chemical Reactor - Composition Control).

In regard to claim 3, **Mathys** discloses that the water content of the feed is controlled with a thermostatted water saturator, as discussed above. This is considered to be a water wash.

In regard to claim 6, **Edgar** discloses analyzers which determine the composition of the feed to the reactor, as discussed above.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Mathys**, in view of **Garwood**, and further in view of **Edgar**, as applied to claim 3 above, and further in view of **Fair**, et al. ("Gas Absorption and Gas-Liquid System Design" in Perry's Chemical Engineer's Handbook, J. Wiley & Sons, D. W. Perry and R. H. Green, eds., 7<sup>th</sup> ed., 1997, available on-line at [www.knovel.com](http://www.knovel.com)).

In regard to claim 4, **Mathys**, in view of **Garwood**, and further in view of **Edgar**, discloses the process of claim 3, as discussed above, but does not appear to explicitly disclose coalescing the water wash before passing the feed to the reactor.

However, **Fair** discloses numerous means for separating and collecting mists and sprays produced by passing gases through liquids (Fig. 14-105). Examples of such collection devices are mesh collectors, tube bank collectors, and inertial/target collectors, i.e., baffled collectors. **Fair** discloses that collection of the liquids results in coalescing of the mist and/or spray (p. 14-82, 1<sup>st</sup> column, 1<sup>st</sup> paragraph).

Therefore, at the time of the invention, it would have been *prima facie* obvious to one of ordinary skill in the art to modify the process of **Mathys**, in view of **Garwood**, and further in view of **Edgar**, and collect and coalesce sprays and/or mists as taught by **Fair**

because (1) this involves application of a known liquid collection/coalescing techniques to improve a known process to yield predictable results and also because (2) such separation is used to prevent yield loss and/or equipment damage or malfunction (**Fair**, p.14-81, 1<sup>st</sup> column, 1<sup>st</sup> paragraph).

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Mathys**, in view of **Garwood**, and further in view of **Edgar**, as applied to claim 2 above, and further in view of **Chang**, et al. (U.S. 4,754,096).

In regard to claim 7, **Mathys**, in view of **Garwood**, and further in view of **Edgar**, discloses the process of claim 2, as discussed above, but does not appear to explicitly disclose the analysis of the reactor feed also includes a measure of the concentration of oxygenated components.

However, **Chang** discloses a process for oligomerizing light olefins by contacting a mixture of olefins and small amounts of water with medium pore zeolite (Abstract). Water is co-fed with the olefin in order to enhance, i.e., increase or maintain, the acidity of the zeolite. **Chang** further discloses that an oxygenated compound such as methanol or other lower aliphatic oxygenate may be added to the process in place of water because such oxygenates generate water (col. 3, lines 47-52).

As noted above, **Edgar** discloses that adequate control of chemical reactions requires control of the stoichiometry and the feed rates of the different components. **Edgar** teaches that the composition of the feeds to the process is commonly measured to accomplish this. It is considered *prima facie* obvious to measure the concentration of

oxygenated components in the olefinic feed because such compounds affect the amount of water present in the process feed, as discussed above.

Therefore, at the time of the invention, it would have been *prima facie* obvious to one of ordinary skill in the art to modify the oligomerization process with feed composition analysis as taught by **Mathys**, in view of **Garwood**, and further in view of **Edgar**, and substitute the oxygenates of **Chang** for water as taught by **Mathys** because this involves substitution of one known prior art hydration source for another known hydration source to obtain predictable results.

Claim 10-11 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mathys**, in view of **Garwood**, as applied to claim 1 above, and further in view of **Cavani**, et al. ("Effect of Water in the Performance of the 'Solid Phosphoric Acid' Catalyst for Alkylation of Benzene to Cumene and for Oligomerization of Propene", Appl. Catal. A, 97 (1993) 177-196).

In regard to claim 10, **Mathys**, in view of **Garwood**, discloses the process of claim 1, as discussed above, but does not appear to explicitly disclose that the conversion is performed in a tubular reactor.

However, **Cavani** discloses propylene oligomerization processes in which propylene is contacted with solid phosphoric acid catalysts (Abstract). **Cavani** further discloses that such oligomerizations may also be conducted by contacting the olefin with zeolite oligomerization catalysts (p. 178, 1<sup>st</sup> paragraph). **Cavani** discusses

commercial oligomerization reactors and teaches that both tubular reactors and chamber reactors are commonly used (p. 179, Experimental, 1<sup>st</sup> paragraph).

Therefore, at the time of the invention, it would have been *prima facie* obvious to one of ordinary skill in the art to modify the **Mathys**, in view of **Garwood**, and utilize a tubular reactor as taught by **Cavani** because (1) this involves use of a known reactor design to improve a similar oligomerization process in the same way and also because (2) tubular reactors can be designed with improved heat transfer in order to obtain uniform reaction temperature (**Cavani**, p. 180, 3<sup>rd</sup> paragraph).

In regard to claim 11, **Cavani** discloses that olefin oligomerization reactor may be a chamber reactor, as discussed above.

In regard to claim 19, **Cavani** discloses a solid phosphoric acid catalyst, as discussed above.

In regard to claim 20, **Cavani** discloses an example in which the temperature is 180°C (p. 183, 1<sup>st</sup> paragraph). **Mathys** discloses that higher oligomerization temperatures, e.g., temperatures ranging from 180°C to 255°C, may also be used. Since a temperature range of 180°C to 255°C overlaps the temperature range of 200°C to 310°C, the range recited in claim 18 is considered *prima facie* obvious.

Claim 16 is are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mathys**, in view of **Garwood**, as applied to claim 1 above, and further in view of **Beech**, et al. (U.S. 4,973,790).

In regard to claim 16, **Mathys**, in view of **Garwood**, discloses the process of claim 1, as discussed above, but does not appear to explicitly disclose that the conversion products are desulfurized.

However, **Beech** discloses a process for oligomerizing a light olefin feed by contact with a shape selective zeolite catalyst (Abstract). The feed is passed through (i) a sulfur-scrubbing step and (ii) a water wash prior to contacting the catalyst. **Beech** discloses that this removes sulfur-containing compounds from the olefin feed prior to contact with the catalyst (col. 2, lines 37-43). Therefore, the conversion products, i.e., oligomerized olefins, are considered to be desulfurized because the sulfur contaminants are removed from the feed by a scrubbing step prior to being oligomerized.

Therefore, at the time of the invention, it would have been *prima facie* obvious to one of ordinary skill in the art to modify the process of **Mathys**, in view of **Garwood**, and include the desulfurization step of **Beech** because (1) this involves use of a known purification technique to improve a similar oligomerization process in the same way and also because (2) sulfur compounds are known poisons for acidic oligomerization catalysts.

### ***Conclusion***

The following prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

(a) **Rabo**, et al. (U.S. 4,740,648) discloses an olefin oligomerization process in which water is added to the feed contacting a zeolite catalyst.

(b) **Beck**, et al. (U.S. 5,773,679) discloses a hydrocarbon conversion process in which water is initially fed to a shape selective zeolite then omitted after a specified period of time.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bradley Etherton whose telephone number is (571) 270-5478. The examiner can normally be reached on Monday through Friday, 7:30 a.m. to 5:00 p.m. EST, with alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, InSuk Bullock can be reached on (571) 272-5954. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Bradley Etherton/  
Examiner, Art Unit 1772  
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